

### Examiner's Amendment

1. An examiner's amendment, to the approved for entry June 6<sup>th</sup> 2008 amendment and response, to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.
2. Authorization for this examiner's amendment was given in a telephone interview with **Attorney Maurice M. Klee, Ph.D. Reg. No. 30,399** on **June 19<sup>th</sup> 2008** along with authorization to charge any necessary fees to applicant's deposit account.
3. The application has been amended as follows:

#### In the Claims

**A) Replace claims 1-2, 4-8 and 10-18 of the June 6<sup>th</sup> 2008 after-final amendment and response with the following Examiner amended claims 1-2, 4-8 and 10-18:**

**Claim 1** --- A radio frequency (RF) coil array configured for use in magnetic resonance imaging and/or magnetic resonance analysis of a subject located within a space in which a homogeneous static magnetic field is operatively applied in a first direction, the RF coil array comprising:

a plurality of individual coil elements angled relative to each other, with each of the individual coil elements (i) being electrically separate from each of the other individual coil elements, and (ii) having a pair of main conductors extending generally parallel to the first direction and located on opposite sides of the space in a single plane, said single plane passing through the middle of the space; and

a connection conductor connected between respective ends of the main conductors, said connection conductor being generally transverse to the first direction. -

**Claim 2** --- An RF coil array as claimed in **claim 1**, wherein the homogeneous space is a cylindrical space. ---

**Claim 4** --- An RF coil array as claimed in **claim 2** wherein the individual coil elements are equi-angularly spaced about the axis of the cylindrical space, the angle between adjacent coil elements being  $360/N$ , where N is the number of coil elements in the array. ---

**Claim 5** --- An RF coil array as claimed in **claim 2**, wherein the connection conductor extends around the periphery of the cylindrical space at an axial end thereof in order to thereby permit access to the cylindrical space through that end. ---

**Claim 6** --- An RF coil array as claimed in **claim 2**, wherein the individual coil elements are arranged in one or more orthogonal pairs with respect to one another. --

**Claim 7** --- A magnetic resonance imaging apparatus comprising:  
a magnet configured for applying a homogeneous static magnetic field in a first direction within an imaging space ~~in a first direction~~ configured for receiving a subject to be imaged;  
~~an imaging space configured for receiving a subject to be imaged;~~  
a radio frequency (RF) coil array comprising a plurality of angularly spaced individual coil elements, each individual coil element being electrically separate from each of the other individual coil elements;  
each individual coil element comprising:  
a pair of main conductors extending generally parallel to the **first** direction and located on opposite sides of the imaging space in a single plane, said single plane passing through the middle of the imaging space; and

a connection conductor connected between respective ends of the main conductors, said connection conductor being generally transverse to the first direction. ---

**Claim 8** --- **A magnetic resonance imaging** apparatus as claimed in **claim 7**, wherein the imaging space is a cylindrical space. ---

**Claim 10** --- **A magnetic resonance imaging** apparatus as claimed in **claim 8**, wherein the individual coil elements are equi-angularly spaced about the axis of the cylindrical space, the angle between adjacent individual coil elements being  $360/N$ , where N is the number of individual coil elements in the array. -

**Claim 11** --- **A magnetic resonance imaging** apparatus as claimed in **claim 8**, wherein the connection conductor extends around the periphery of the cylindrical space at an axial end thereof **in order** to thereby permit access to the cylindrical space through that **axial** end. ---

**Claim 12** --- **A magnetic resonance imaging** apparatus as claimed in **claim 8**, wherein the individual coil elements are arranged in one or more orthogonal pairs with respect to one another. ---

**Claim 13** --- **A magnetic resonance imaging** apparatus as claimed in **claim 7**, wherein each individual coil element is used as a receiver coil, the **magnetic resonance imaging** apparatus further comprising:

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a plurality of receiver channels each connected to a respective individual coil element, and

a means for combining the signals from each individual coil element in order to form a composite **MRI** image **of the subject**. ---

**Claim 14** --- **A magnetic resonance imaging** apparatus as claimed in **claim 7**, wherein at least one individual coil element is utilized as both a transmitter and receiver coil. ---

**Claim 15** --- **A magnetic resonance imaging** apparatus as claimed in **claim 7**, wherein the individual coil elements are arranged in one or more orthogonal pairs, the individual coils elements of a pair being orthogonal with respect to one another, one individual coil element in each orthogonal pair being utilized as a transmitter coil and the other individual coil element in each orthogonal pair being utilized as a receiver coil, each orthogonal pair being sequentially active, the **magnetic resonance imaging** apparatus further comprising:

a receiver channel and

a switch **configured** for selectively connecting the receiver channel sequentially to the receiver coil of the active orthogonal pair. ---

**Claim 16** --- **A magnetic resonance imaging** apparatus as claimed in **claim 15**, wherein each transmitter coil of each orthogonal pair generates a radio frequency pulse of different amplitude and phase from that generated by the transmitter coil(s) of the other orthogonal pair(s). ---

**Claim 17** --- A rotary switched RF coil array arrangement configured for combined parallel magnetic resonance imaging of a subject located in a cylindrical imaging space in which a homogeneous static magnetic field is operatively applied in a first direction, the RF coil array arrangement comprising:

a plurality of individual coil elements spaced angularly about the axis of the cylindrical imaging space, each individual coil element being electrically separate from each of the other individual coil elements and including

a pair of main conductors extending axially on diametrically opposite sides of the cylindrical imaging space in a single plane, said single plane passing through the middle of the cylindrical imaging space; and

a connection conductor connected between respective ends of the main conductors, said connection conductor being generally transverse to the first direction;

a receiver channel; and

a switch configured for selectively connecting the receiver channel sequentially to the individual coil elements of the RF coil array. ---

**Claim 18** --- An RF coil array arrangement as claimed in **claim 17**, wherein the connection conductors are non-diametrical at an axial end of the cylindrical imaging space in order to permit access into the cylindrical imaging space at that axial end of the cylindrical imaging space. ---

**B)** Cancel claims 3, and 9 as per the **June 6<sup>th</sup> 2008 After-final amendment** which has been approved and marked OK for entry by the examiner.

**In the Specification**

**C) Replace the first paragraph**, after the heading of "BRIEF SUMMARY OF THE INVENTION" found **on page 3 of the originally filed February 25 2005 specification**, **with the following examiner amended paragraphs** which properly provide a full description of the additional reference labels for the examiner approved after-final amended drawings of June 6<sup>th</sup> 2008.

---In one broad form, the invention provides a radio frequency (RF) coil array **configured** for use in **magnetic** resonance imaging and/or **magnetic resonance analysis** of a subject located within an **imaging** space in which a **static** magnetic field is operatively applied in a first direction, the **RF** coil array comprising a plurality of **individual** coil elements angled relative to each other and electrically separate from each other, each **individual** coil element having a pair of main conductors extending generally parallel to the direction of the magnetic field and located on opposite sides of the **imaging** space, and a pair of connection conductors connected between respective ends of the main conductors, **said connection conductor being generally transverse to the first direction**.

As can be seen in FIGS. 3, 4, 5, 6, and 8, in addition to being on opposite sides of the **imaging** space in which the **static** magnetic field is applied, the main conductors of each individual coil element are also located in a single plane that passes through the middle of the imaging space so that each individual coil element has its maximum sensitivity close to the centre of the subject. For example, in FIG. 3, the main conductors of coil element 10 are located in a first plane and the main conductors of coil element 11 are located in a second plane which, in this case, is orthogonal to the first plane. Similar single planes for the main conductors of each individual coil element **are shown** in Figs. 4, 5, 6, and 8. As **shown** in FIGS. 3, 4, 5, 6, and 8, the connection conductors are generally transverse to the direction (**i.e.** the first direction) in which the **static** magnetic field is applied. ---

The following is an examiner's statement of **Reasons for Allowance**:

4. With respect to **independent claims 1, 7, and 17**: These claims are considered to be allowable over the prior art of record because the prior art of record neither discloses nor suggests a radio frequency coil array comprising “a plurality of individual coil elements spaced angularly about the axis of the cylindrical imaging space, each individual coil element being electrically separate from each of the other individual coil elements and including a pair of main conductors extending axially on diametrically opposite sides of the cylindrical imaging space in a single plane, said single plane passing through the middle of the cylindrical imaging space; and a connection conductor connected between respective ends of the main conductors, said connection conductor being generally transverse to the first direction” in combination with the remaining limitations of each of the examiner amended independent claims. **The examiner notes that this configuration has a functional advantage over the prior art of record because the physical structure itself is arranged so that functionally, each individual coil element has its maximum sensitivity close to the centre of the subject** This is contrary to the prior art where in the prior art each individual coil element has its maximum sensitivity close to the periphery or surface of the subject. Applicant's configuration designs an RF coil array which has the advantage of establishing a single plane passing through the middle of the cylindrical imaging space so that each individual coil element has its maximum sensitivity close to the centre of the subject, in a manner not heretofore known, taught, suggested, or rendered obvious by the prior art of record. It is however, the entire combination of the claim limitations taken as a whole that constitutes both the novelty and non-obviousness of applicant's claims, because it is the complete combinational structural configuration that is not found within the prior art of record.
5. Additionally, the examiner notes that within these claims the **rotary switched RF coil array arrangement is** interpreted by the examiner as being a **Phased array rotary switched RF coil**, because the arrayed coil elements are configured to have via their locations a different phase with respect to one another and the examiner is considering

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the element as such. Support for the examiner's interpretations and the functional significance of applicant's coil structure is fully provided on page 2 of the original specification.

6. With respect to **examiner amended dependent claims 2, 4-6, 8, 10-16 and 18**: These claims are considered to be allowable over the prior art of record because they each depend from an allowable examiner amended independent claim.

7. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

#### **Examiner's Comment**

##### ***Priority***

8. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

##### ***Drawings***

9. The drawings filed with the after-final amendment of **June 6<sup>th</sup> 2008** are approved by the examiner for entry because the amendments simply provide clarification labels to the structures shown in the originally filed drawings. No new matter has been added. The labels set forth in the after-final amended drawings of the **June 6<sup>th</sup> 2008** further show the separate components set forth in the claims, so that all required components are clearly depicted without ambiguity as to what structural component is being referenced in the labeled drawings. The applicant's Remarks **of June 6<sup>th</sup> 2008** concerning the after-final correctly labeled of drawings for figures 5, 6, and 8 found on page 7 of that response with respect to replacement sheets 3/8, 4/8, and 6/8 of the **June 6<sup>th</sup> 2008** after-final amendment and response are also noted by the examiner, as further reasons why the after-final amended claims are considered to be free of new matter.

##### **Prior Art of Record**

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.



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**A) Visser et al.**, US patent 6,870,368 B2 issued March 22<sup>nd</sup> 2005, filed February 5<sup>th</sup> 2002.

**B) Visser et al.**, US patent application publication **2002/0125888 A1** published **September 12<sup>th</sup> 2002**, filed February 5<sup>th</sup> 2002. This reference corresponds to the applied **Visser et al.**, US patent 6,870,368 B2

**C) Boskamp et al.**, US patent 6,590,392 B2 issued July 8<sup>th</sup> 2003, filed April 17<sup>th</sup> 2001.

**D) Boskamp et al.**, US patent application publication **2002/0149367 A1** published **October 17<sup>th</sup> 2002**, filed April 17<sup>th</sup> 2001. This reference corresponds to the applied **Boskamp et al.**, US patent 6,590,392 B2

**E) Fox.**, US patent 4,763,074 issued August 9<sup>th</sup> 1988.

### Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday, Wednesday, and Friday-Thursday from 7:00am to 2:10 pm., and on Tuesday and Thursday from 7:00am to 5:30pm.

12. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, **Diego Gutierrez**, can be reached at (571) 272-2245. The **only official fax phone number** for the organization where this application or proceeding is assigned is **(571) 273-8300**.

13. Information regarding the status of an application may be obtained from the Patent Application information Retrieval (PAIR) system Status information for published applications may be obtained from either Private PMR or Public PMR. Status information for unpublished applications is available through Private PMR only. For more information about the PMR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PMR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TAF  
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/Brij B Shrivastav/  
Primary Patent Examiner  
Technology Center 2800